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(54) **Title:** METHODS AND DEVICES FOR RECORDING OR READING FILES ON/FROM A SEQUENTIAL MEDIUM AND SEQUENTIAL MEDIUM
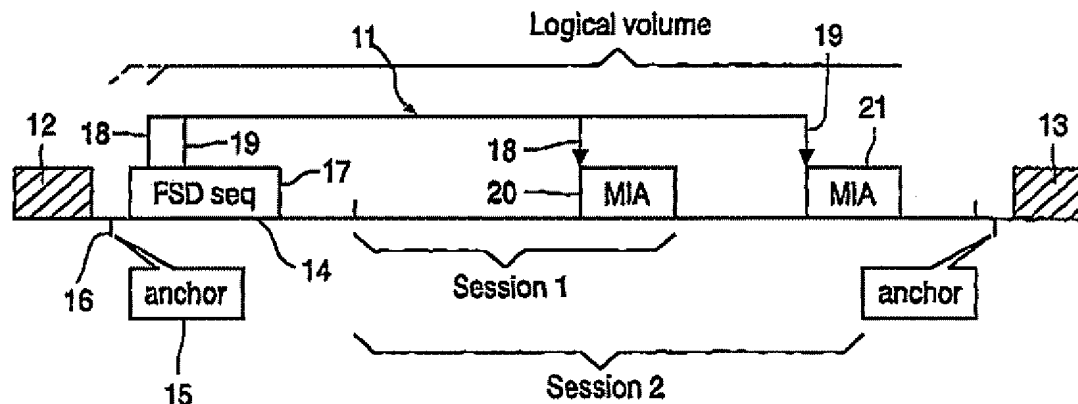
(57) **Abstract:** The invention relates to a method and a device for reading and a method and a device for recording files on a sequential medium as well as the sequential medium itself. In order to enable the use of sequential write-once mediums according to the invention the file system descriptor pointing to a current version of a management information area is recorded on a reserved track being located at the beginning of the volume. Thereby, the management information area is recorded at a location behind files being recorded onto the volume.

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Methods and devices for recording or reading files on/from a sequential medium and sequential medium

The invention relates to the recording and reading of files on a sequential medium including recording or reading of a management information area storing data structures that are used for volume and file management and recording or reading files onto the volume. Furthermore, the invention relates to a sequential medium comprising such a
5   management information area and a volume containing files.

Known optical digital video recording discs consist of a lead-in, a data and a lead-out area. A drive presents the data area to the file system. In general, a file system uses part of the data area for its own administration purposes and presents the remainder in some suitable way, using partitions, as a so-called logical volume, i.e., a logical contiguous address
10   space to an application. Typically a file system uses an anchor descriptor at so-called anchor points to find a reference to its management information area for volume structure.

JAFS (Joint Approach File System) is a volume and file management system intended to be used for both AV (Audio and Video) and computer applications. Most of the existing volume and file management systems are designed to be used only for computer
15   applications, therefore they lack the functions necessary for AV applications such as real time data reading and writing, or file dividing and combining without data movement. JAFS is designed to enable implementation of the above and other functions useful for AV applications in an effective manner.

The JAFS file system is defined for a randomly rewritable medium. Due to
20   this definition problems occur, when using a sequential write-once medium.

It is therefore an object of the present invention to provide a definition of such a file system that also works for a sequential write-once medium.

This object is achieved by providing a method for recording files as set forth in claim 1, a method for reading files as set forth in claim 7, a device for recording files as set
25   forth in claim 8, a device for reading files as set forth in claim 9, and a sequential medium as set forth in claim 10.

The invention enables to modify, in particular add or remove, files on a sequential, in particular write-once, medium such as a DVR-R (digital video recorder-recordable) medium. Thereby, the management information area needs to be updated by

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writing a new version of the management information area. As the data already recorded on the medium cannot be rewritten in a sequential write-once medium the management information area has to be written as a new version at the end of files or data, such as management information area data already recorded on the medium.

5   Thus, new files added to the existing files are being registered in a new version of the management information area. Accordingly, removed files are no longer registered in the current management information area, thus appearing to be deleted, even though the data of these removed files is still on the medium.

          As the management information area according to the present invention is
10   located at the end of the files recorded on the medium, it is a problem to quickly find the current version of the management information area. However, a file system descriptor being located somewhere after the lead-in, i.e. at the beginning of the data track between the lead-in and lead-out area, points to the management information area. Thus, the management information area can be accessed rapidly.

15   The file system descriptor is written in a reserved track that is located somewhere after the region of a lead-in area, i.e. near by the beginning of the medium. Thus, the file system descriptor maybe accessed instantaneously. As the file system descriptor is written in a reserved track having a capacity, in particular in terms of bytes, being much larger than the file system descriptor itself, new file system descriptors may be written in the
20   reserved track in order to specify the current location of the management information area.

          Embodiments and modifications may be taken from the sub-claims and will be described in more detail with reference to the accompanying drawings, in which:
25   Figure 1 shows a diagram of a data system of an optical DVR disc according to the prior art JAFS specification;

          Figure 2 shows a data system according to a preferred embodiment of the present invention;

          Figure 3 shows an anchor descriptor;
30   Figure 4 shows a schematical diagram of an device for recording and/or reading files on an optical DVR disc.

          The following definitions are used in connection with the present invention:

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The term "medium" defines means on which data is recorded.

The term "management information area" or MIA is a set of physical or logical sectors of which the sector numbers are consecutive. It is used to record data structures in units of physical or logical sectors. Data structures that are used for volume and

5　file management are stored in the management information area. Various pieces of information about a volume are recorded in a management information area.

Preferably, in order to assure reliability, two management information areas for volume structure, in which two identical sets of information are recorded, shall be recorded on a physical volume. These are referred to as the main management information

10　area for volume structure and the reserve management information area for volume structure.

The term "partition" represents a collection of physical sectors with continuous physical sector numbers in a physical volume.

The term "logical volume" is defined as a sequence of partitions. A logical volume may have partitions on different physical volumes. Thus, a logical volume may be

15　constructed from partitions belonging to different physical volumes.

The term "descriptor" specifies the starting address and size of the main anchor or the reserve management information area and the location of the management information area map in the main and the reserve management information area. The locations where other anchor descriptor can be recorded are referred to as the anchor points.

20　Figure 1 shows a diagram of an optical digital video recording disc 1 consisting of a lead-in area 2, a data area 3, and a lead-out area 4. A drive (not shown) presents the data area 3 to a file system. The file system uses an anchor descriptor 5 at a so-called anchor point 6 to find a reference to its management information area 7 for file structure. The management information area 7 stores information about the data structure in a

25　logical volume 8. A further anchor descriptor 9 is located at a further anchor point 10 near by the lead-out area 4.

The data structure as shown in figure 1 may not be modified in terms of adding or removing files in case of using a sequential write-once medium, as a recordable, but only, when using a randomly rewritable medium. If files are modified, in particular

30　added, removed, divided, or combined, the management information area 7 needs to be updated. However, this is not possible when using the structure shown in figure 1 in combination with a sequential write-once medium.

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Figure 2 shows the structure of an optical digital video recording disc according to the invention. Similar to figure 1, a data area 11 is located between a lead-in area 12 and a lead-out area 13.

However, contrary to figure 1, a management information area is not located near by the lead-in area 12. Moreover, a reserved track 14 is located near by the lead-in area 12 being found by an anchor descriptor 15 at an anchor point 16. In particular, the reserved track is located at the beginning of the logical volume.

The reserved track 14 contains a sequence 17 of file system descriptors (FSD) 18, 19.

A first file system descriptor 18 points to a first management information area 20 belonging to session 1. However, since a further session has been created, namely session 2, a second file system descriptor 19 has been recorded in the reserved track 14 pointing to a second management information area 21, namely according to the embodiment of figure 2 the current management information area.

Even though the first management information area 20 is still physically on the disc, this first management information area 20 is no longer valid due to the creation of the second management information area 21. Thus, e.g. files contained in session 1 may have been removed logically, even though they still physically exist on the disc. However, they cannot be accessed any longer. Files added during session 2 are located between the first management information area 20 and the second management information area 21.

If the subsequent session is being created this is done by recording a new management information area located behind the files being added during the subsequent session, that are being recorded behind the preceding management information area. However, if no files have been added but some files from the preceding session have been removed or renamed, a new management information area is recorded adjacent to the preceding management information area, i.e. at a location behind the preceding management information area. However, in any case the management information area is recorded at the end of a session.

Every time a new management information area is recorded, a further file system descriptor is added to the sequence of file system descriptors in the reserved track. The latest file system descriptor is pointing to the current version of the management information area.

Figure 3 shows a proposed anchor descriptor as being recorded at an anchor point, including a signature, a file system type, a reserved data block, a start address of

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logical volume, a length of logical volume, a start address of file system descriptor sequence, and a length of file system descriptor sequence.

The start address of the logical volume is a physical address. The length of the logical volume is in physical sectors. The start address of the file system descriptor sequence is a logical address. The length of the file system descriptor sequence is in logical sectors.

5   If the file system type is random access, the file system descriptor sequence consists of one file system descriptor. However, if the file system type is sequential, all file system descriptors in a file system descriptor sequence shall be aligned at error correction code blocks and the file system descriptor sequence shall be terminated by an unrecorded

10   block.

An example is given in order to illustrate this situation of file system descriptors in more detail:

Assumed is a 24 GB digital video recording recordable disc (DVR-R disc). If one wants to add in increments of five minutes audio/video data at a bit rate of 4 Mbit/s (=

15   150 MB), then 24 GB/150 MB = 160 file system descriptors 18, 19 in the file system descriptor sequence need to be recorded. Assumed that an error correction code block is 64 kB, this takes about 10 MB.

If the number of increments shall not be limited, the pointer descriptor to the next file system descriptor sequence is defined, thus preferably resulting in more than one file

20   system descriptor sequences on one disc or medium.

Preferably, for robustness reasons, a separate reserve file system descriptor sequence is added.

Figure 4 shows a schematical diagram of a device for recording and/or reading files on an optical DVR disc, the device including a drive means 22, e.g. an electrical motor

25   for driving the optical DVR disc 1. The drive means 22 is connected to a microprocessor 23 by means of an electrical cable 24. The microprocessor is connected with means 25 for reading and/or recording files on the optical DVR disc by means of a data bus 26.

The microprocessor 23 is programmed in order to cause in a recording mode the means 25 to record a management information area 20, 21 at a location behind the above-

30   mentioned files and to record a file system descriptor 18, 19 pointing to the current version of the management information area 21 onto the reserved track 14 at a location at the beginning of the volume.

Furthermore, the device is programmed in order to cause in a reading mode the means 25 to read the reserved track 14 containing the file system descriptor 18, 19 at a

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location at the beginning of the volume and then to read the management information area 20, 21 from a location behind the files by means of the file system descriptor 18, 19 pointing to the current version of the management information area 21.

5   Summarized the main idea of the invention is to start a sequential medium with a reserved track that contains a file system descriptor pointing to the current management information area being located at the end of the latest session thus enabling access to files added and not being removed during the current session and during previous sessions. As the current management information area contains the information to access files, files that are not registered in the current management information area are excluded 10 from the current session, thus appearing to be deleted.

The invention may be embodied in terms of a method for reading and a method for recording data on a medium according to the described data structure as well as in terms of corresponding devices for reading or recording data of that structure, i.e. for carrying out said methods.

15   Furthermore, a data carrier or medium recorded by such a method or by such a device is a product according to the invention. It may be read by a method or device for reading such data structure. Therefore, protection is sought according to the independent claims.

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CLAIMS:

1.   A method for recording files on a sequential medium (1), said method comprising the steps of

a)   recording a management information area (20, 21) storing data structures that are used for volume and file management and

5   b)   recording files onto the volume
characterized by

c)   recording the management information area (20, 21) at a location behind said files and

d)   recording a file system descriptor (18, 19) pointing to the current version of

10   the management information area (20, 21) onto a reserved track (14) being located at the beginning of the volume.

2.   A method according to claim 1,
characterized by recording the management information area (20, 21) at the end of a session

15   (session 1, session 2).

3.   A method according to claim 1 or 2,
characterized by creating a subsequent session (session 2) by recording a new management information area (21) located at a location behind the preceding management information

20   area (20) or behind files being added during the subsequent session (session 2) behind the preceding management information area (20).

4.   A method according to claim 3,
characterized by recording a further file system descriptor (19) onto the reserved track (14)

25   pointing to the current version of the management information area (21).

5.   A method according to claim 1,

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characterized in that the reserved track (14) is located at a predetermined position near by a lead-in area (12) of the medium (1).

6. A method according to claim 1,
5 characterized by aligning the file system descriptors (18, 19) at error correction code blocks and terminating a sequence (17) of file system descriptors (18, 19) by an unrecorded block.

7. A method for reading files from a sequential medium, said method comprising the steps of
10 a) reading a management information area (20, 21) storing data structures that are used for volume and file management and
b) then reading files from the volume
characterized by
c) reading first a reserved track (14) containing a file system descriptor (18, 19)
15 and being located at the beginning of the volume and
d) reading then the management information area (20, 21) from a location behind said files using the file system descriptor (18, 19) pointing to the current version of the management information area (20, 21).

20 8. A device for recording files on a sequential medium (1) comprising recording means for recording a management information area (20, 21) storing data structures usable for volume and file management and for recording files onto a volume
characterized by
programmable microprocessor means being connected to the recording means and being
25 programmed in order to cause the recording means to record said management information area (20, 21) at a location behind said files and to record a file system descriptor (18, 19) pointing to the current version of the management information area (21) onto a reserved track (14) at a location at the beginning of the volume.

30 9. A device for reading files from a sequential medium comprising reading means for reading a management information area (20, 21) storing data structures that are used for volume and file management
characterized by

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programmable microprocessor means being connected to the reading means and being programmed in order to cause the reading means to read a reserved track (14) containing a file system descriptor (18, 19) and being located at the beginning of the volume and then to read the management information area (20, 21) from a location behind said files by means of
5   the file system descriptor (18, 19) pointing to the current version of the management information area (21).

10.   Sequential medium comprising a management information area storing data structures that are used for volume and file management and for reading files from a volume
10   and a logical volume containing files
       characterized in that it further comprises a reserved track to record a sequence (17) of file system descriptors (18, 19), the latest file system descriptor (18, 19) pointing to a current version of the management information area (20, 21), the reserved track being located near by a lead-in area (12) of the medium,
15   the current version of the management information area (21) is located at the end of the files recorded on the medium, said files being located between the reserved track (14) and the current version of the management information area (21).

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FIG. 1

FIG. 2
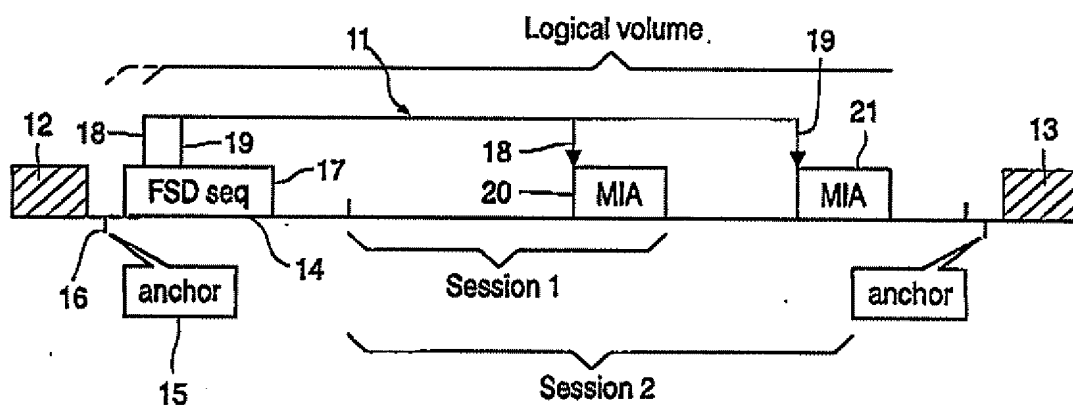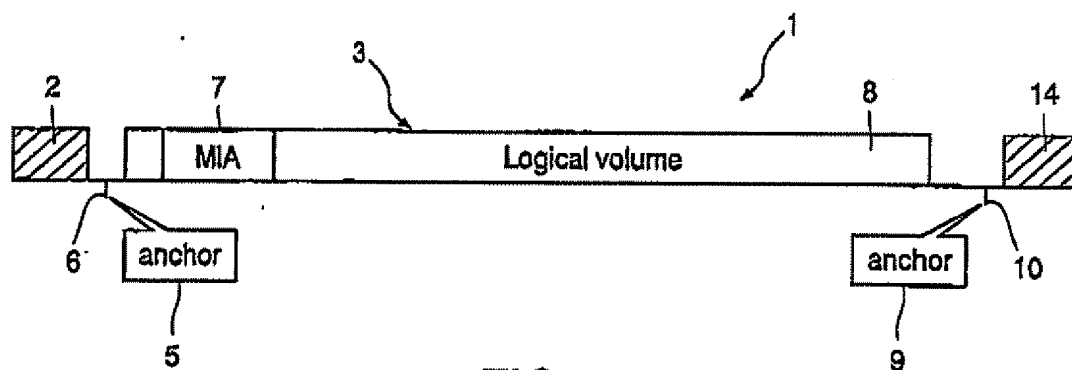
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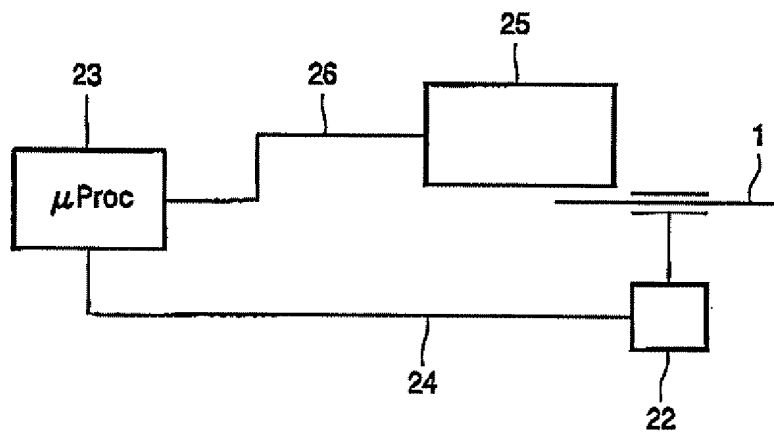| BP	Length	Name	Contents
0	8	Signature	SigRec
8	1	File System type	Uint8
9	3	Reserved	#00 bytes
12	4	Start Address of Logical Volume	Uint32
16	4	Length of Logical Volume	Uint32
20	4	Start Address of File System Descriptor Sequence	Uint32
24	4	Length of File System Descriptor Sequence	Uint32

FIG. 3

FIG. 4